new experiment the phenomena became less distinct than they were before.]

I think it most probable that, properly speaking, *electric light does not exist*; *the light which we see belongs to the gas, rendered incandescent by the thermal action of the current.* Accordingly, in our case, the colour of the appearing light depends upon the nature of the gas and the concentration of the current. This opinion is strongly supported by the observed fact, that the temperature of the capillary tube increases considerably in some instances. Considering that this increase of temperature has its source in the heat of the residual gas, which is too small in amount to be indicated by the balance, this heat being produced by the electric current, and communicated to the heavy substance of the tube; we have scarcely an idea of the *enormous* temperature of the gaseous electrode included in the capillary channel*.

II. "On the Interruption of the Voltaic Discharge in Vacuo by Magnetic Force." By J. P. Gassiot, Esq., F.R.S. Received December 6, 1859.

The late Professor Daniell, in his Fifth Letter on Voltaic Combinations (Phil. Trans. 1839, part 1), describes some experiments made with seventy series of his constant battery, and states (page 93) "that the arc of flame between the electrodes was found to be attracted and repelled by the poles of a magnet, according as one or the other pole was held over or below it, as was first ascertained by Sir H. Davy; and the repulsion was at times so great as to extinguish the flame."

In the Philosophical Magazine of July 1858, Mr. Grove has described an experiment made by him with one of my vacuum-tubes, 2 feet 9 inches long, in which he ascertained that the discharge of a Ruhmkorff's induction coil could be stopped by bringing a magnet near the positive terminal wire, but that this effect was not obtained when the magnet was made to approach the negative. The mercurial vacuum-tube in which Mr. Grove observed this phenomenon was

* In some peculiar cases my primitive theoretical views were modified, reformed, or extended by subsequent experiments. The abstract now given refers only to what I think *at present* to be the state of the question.

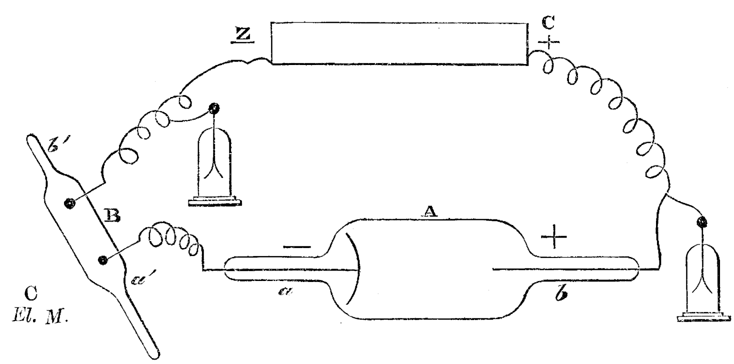
unfortunately shortly afterwards broken; and although Mr. Grove and myself have repeatedly endeavoured to obtain the same result in similar and in other vacuum-tubes (and since that period I have experimented with upwards of two hundred), all our efforts have been hitherto unsuccessful.

The experiments I am now about to describe were made with two carbonic acid vacuum-tubes, the vacua being obtained in the same manner as described by me in the Philosophical Transactions, part 1, 1859.

A, in the annexed figure, represents a glass tubular vessel (No. 146), 24 inches long and 6 inches diameter in its wide part; at one end, attached to the platinum wire (*a*), is a concave copper plate 4 inches diameter, at the other end is a brass wire attached to the platinum wire (*b*). B represents a glass tube (196) 5 inches long (in its wide part), in which two small balls of gas-retort coke are attached to the platinum wires *a′* and *b′*, and are placed about 3 inches apart, all the platinum wires being hermetically sealed in the glass. In A the potash is placed in the vessel between the electrodes; in B it is placed in the further part of the tube, beyond one of the wires.

An electro-magnet is placed at C, and is constructed so as to allow the two helices to be separated; and by these means the larger vessel can, if required, be placed between them, and any portion of the luminous discharge may be thus exposed to any part of the magnetic field.

Battery.



* The carbon-balls do not in these experiments affect the results described, as I have obtained the same in a tube of the same dimension with brass wires.

When the terminals of an excited induction coil are attached to the wires of either of the above vacuum-tubes A or B, luminous discharges are obtained, the negative wire ball or plate being covered with a luminous cloud-like glow extending towards the positive; but the stratifications are not developed, except by the magnet, and these become more clearly defined as the magnet is caused to approach, or as the power is increased, when they are deflected according to the direction of the discharge, or of the polarity of the magnet. But with the induction coil, no matter how I reduced the intensity of the discharge, or varied that of the electro-magnet, in no instance could I produce in these, or in any of my vacuum-tubes, a similar result to that which Mr. Grove obtained in the vacuum-tube so unfortunately broken; the experiment evidently requires a certain balance of power between the electric discharge and that of the magnet, and this I had hitherto been unsuccessful in obtaining.

I next experimented with my water-battery (Phil. Trans. 1844, and Proceedings, 26 May, 1859), which I have recently had carefully cleaned and recharged with rain-water; the luminous discharge in both the vacua A and B was obtained with less than 1000 series, and this discharge, as well as that from the full series of the battery of 3520 cells, was under certain conditions, hereafter described, entirely destroyed or interrupted by the power of the magnet.

At first the interruption or break in the luminous discharge appeared to be caused by the sudden action of the magnet, as if it were merely momentarily blown out, for the discharge recovered itself while it remained under the influence of the magnet—the luminous discharge under this condition gradually reappearing stratified and strongly deflected; but I subsequently ascertained that, by carefully adjusting the intensity of the battery discharge, and the force or power of the electro-magnet, this recovery in the discharge could be entirely prevented.

On approaching the vacuum A towards the electro-magnet, the luminous discharge from the battery assumed the same form as that from the induction coil; but when the vacuum was placed between the helices, so as to permit the armatures or poles of the magnet to touch one or each side of the glass vessel at about its centre, the discharge disappeared; as soon as the magnet was removed, or the

vacuum-tube withdrawn from its influence, the luminous discharge was reproduced.

To test whether a complete disruption of the electrical current had taken place, two gold-leaf electroscopes were attached, one to the zinc and the other to the copper terminal of the water-battery ; the leaves diverged with considerable energy ; connection was then made from the electroscopes to the wires of the vacuum-tube ; the luminous discharge became visible, and the leaves of both electroscopes partially collapsed ; the vacuum-tube was then placed as before, between the armatures of the electro-magnet, and immediately the magnet was excited, the luminous discharge disappeared, and the leaves of the electroscopes diverged to their original maximum extent, thus proving the disruption to be complete.

If the smaller tube B is placed across both poles of the magnet, the luminous discharge at its centre assumes the appearance of being *nearly* separated into two parts, each part showing a tendency to rotate round the pole of the magnet on which it is placed, the one in an opposite direction to the other. I endeavoured to obtain a disruption of the battery discharge when in this state, and possibly with a more powerful electro-magnet this experiment would succeed ; but although I reduced the intensity of the battery discharge and increased the power of my electro-magnet, I could not in this manner obtain an actual discontinuity of the battery discharge ; but when the same vacuum-tube was placed in a longitudinal or equatorial position between the poles, or even approached them within three or four inches in that direction, an immediate interruption of the discharge took place.

When both vacuum-tubes are placed in the battery circuit, the interruption can be shown in a very striking manner : the general arrangement of the apparatus represented in the figure shows how this experiment is made. A is fixed on a wooden support. One wire (*b*) is attached to the copper terminal of the battery, the other wire (*a*) being connected to one of the wires in B, which is held by the hand, the other wire (*b*′) being connected with the zinc terminal of the battery, gold-leaf electroscopes being placed as before. In this manner all the apparatus is fixed except B, which being held by the hand, and the connecting wires being flexible, can be placed in any required position.

As long as the vacuums are at a sufficient distance from the action of the magnet, the luminous discharge is visible in both, and the leaves of the electroscopes partially collapse ; but immediately the discharge in B is placed in the position described in the previous experiment, between the poles of the magnet, the discharges in *both* vacua instantly disappear, and the leaves of the electroscopes diverge to their original maximum.

The actual position of what is termed the magnetical field, around and between the poles of a magnet, has been generally delineated by means of iron filings placed between the poles on a sheet of paper. Assuming the lines in which these particles arrange themselves to represent the direction of the power of the magnet, or the magnetic field, they also explain the actual position through which the vacuum-tube should be placed to obtain the preceding result, and in this manner to show by experiment that a voltaic discharge which has sufficient intensity to pass through a space of upwards of 6 inches in attenuated carbonic acid gas is not only interrupted, but absolutely and entirely arrested by magnetic force.

Postscript (received Jan. 19, 1860).—In repeating the experiments with Dr. Tyndall in my laboratory, the disruption of the luminous discharge *in vacuo* from 400 cells of the nitric-acid battery was obtained : some most beautiful and striking results were obtained from the same battery on the 16th inst., on repeating the experiment in the Theatre of the Royal Institution, with its large electro-magnet, Dr. Faraday and Dr. Tyndall being present.

The large receiver (146) was placed between the poles of the electro-magnet, the lines of force going through it; electrodes equatorial. The stratified discharge was extinguished. Subsequently, through the sinking of the battery, or some other cause, the stratifications disappeared, and the luminous glow which filled the entire tube remained. On now exciting the magnet with a battery of ten cells, effulgent strata were drawn out from the positive pole, and passing along the upper or under surface of the receiver, according

to the direction of the current. On making the circuit of the magnet, and breaking it immediately, the luminous strata rushed from the positive and then retreated, cloud following cloud with a deliberate motion, and appearing as if swallowed by the positive electrode.

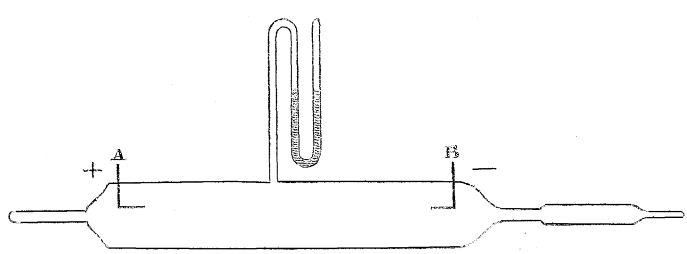
The amount of electricity which passed appeared materially increased on exciting the magnet; once the discharge was so intense as to fuse half an inch of the positive terminal.

After this had occurred, the discharge no longer passed as before when the terminals of the battery were connected with it; but on connecting the positive end of the battery with the gas-pipes of the building, the discharge passed.

The discharge could also be extinguished by the magnet; and the time necessary to accomplish this, furnished a beautiful indication of the gradual rise and reduction in the power of the electro-magnet.

III. "On Vacua as indicated by the Mercurial Siphon-Gauge and the Electrical Discharge." By J. P. Gassiot, Esq., F.R.S. Received January 19, 1860.

That the varied condition of the stratified electrical discharge is due to the relative but always imperfect condition of the vacuum through which it is passed, is exemplified by the changes which take place in the form of the striæ while the potash is heated in a carbonic acid vacuum-tube. In order, if possible, to measure the pressure of the vapour, I had a carefully prepared siphon mercurial gauge sealed into a tube *fifteen* inches long, at an equal distance between the two wires A, B.



This tube was charged with carbonic acid in the manner described